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OPERATING SYSTEM (GATE 2023) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(33) | CORRECT(23) | INCORRECT(9) | SKIPPED(1)

Q. 11 Have any Doubt ?

Consider a system has four free non-adjacent memory partitions (holes) of size 200 KB, 400 KB, 600 KB and 300 KB. System allocate variable size partitions with contiguous memory allocation, and uses worst-fit strategy for memory allocation. Assume, system has memory requests from five processes P_0, P_1, P_2, P_3 and P_4 of size 245 KB, 50 KB, 175 KB, 190 KB and 210 KB respectively in given order (P_0 requests first and P_4 requests last). The size of free memory partition (hole) created on allocation of memory to process P_2 is _____ KB.

180 — Your answer is Correct180

Solution :
180

Initial	200 KB	400 KB	600 KB	300 KB
P_0			−245 KB	
P_1		400 KB −50 KB	355 KB	
P_2		350 KB	355 KB −175 KB	
P_3		350 KB −190 KB	180 KB	
P_4		160 KB		300 KB −210 KB
				90 KB

QUESTION ANALYTICS +

Q. 12 Have any Doubt ?

Which of the following is/are correct?

A. Two or more processes can concurrently execute the same program. — Your option is Correct

B. A process and its child process share the code/program at physical memory because it is static.

C. A process in user mode cannot execute priviledged instructions. — Your option is Correct

D. Threads of a process share the code/program at physical memory because it is static. — Your option is Correct

YOUR ANSWER - a,c,d | CORRECT ANSWER - a,c,d | STATUS - ✓

Solution :
(a, c, d)
(a) Parent and child can execute the same program.
(b) Child creation make copy of physical memory. Also consider exec( ) call.

QUESTION ANALYTICS +

Q. 13 Have any Doubt ?

Consider a system has four processes P_0, P_1, P_2 and P_3. System want to synchronize these processes, such that
(i) First P0 start its body/code and finish it before all other processes.
(ii) P_3 start at last after all other processes finishes their execution.
(iii)P_1, P_2 execute code concurrently.
System uses three counting semaphores S_1, S_2 and S_3 with initial value of 0 for all (S_1 = 0, S_2 = 0,S_3 = 0). Which of the following synchronize implementation/pseudocode is satisfying above condition?

(a)
```
P0 :            P1 :            P2 :            P3 :
{               {               {               {
    code;           P(S1);          P(S2);          P(S3);
    V(S1);          code;           code;           code;
}               V(S2);          V(S3);          }
                }               }
```

(b)
```
P0 :            P1 :            P2 :            P3 :
{               {               {               {
    code;           P(S1);          P(S2);          P(S3);
```

```
    V(S1);          code;          code;          code;
    V(S2);      }              }              }
    V(S3);
}
```

(c)
```
P0 :            P1 :           P2 :           P3 :
{               {              {              {
    code;           P(S1);         P(S1);         P(S2);
    V(S1);          code;          code;          P(S3);
    V(S1);          V(S2);         V(S3);         code;
}               }              }              }
```

(d) All of the above

A a

B b

C c — Your option is **Correct**

D d

YOUR ANSWER - c | CORRECT ANSWER - c | STATUS - ✓

Solution :

(c)
(a) P_1 and P_2 can execute only sequentially (P_1 then P_2), but not concurrently.
(b) Here P_2 can finish before P_1 and P_2.
Option (c), satisfy all conditions.

QUESTION ANALYTICS +

Q. 14 — Have any Doubt ?

Consider a Unix-like file system in which an index node (inode) of a file contains 10 direct, 2 single indirect, and 1 double indirect pointers. Disk block size is 8 KBytes and block address is 64 bit long. Assume a file F stored in file system and inode of F has 10 direct pointers and 2 single
indirect pointers, but 1 double indirect pointer is NULL. And blocks pointed by 2 single indirect pointers are completely filled (no pointer is NULL). The size of file without considering inode block is _____ MBytes. (Upto 2 decimal places)

16.078 [16.07 - 16.08] — Your answer is **Correct**16.08

Solution :
16.078 [16.07 - 16.08]

$$\text{Block size (BS)} = 8\text{ KB}$$
$$\text{Block address (BA)} = 64\text{ bits} = 8\text{ B}$$
$$\text{Addresses per block} = \frac{8\text{ KB}}{8\text{ B}} = 1\text{ K} = 2^{10}$$
$$\text{Size of file F} = [(\text{Number of direct pointer}) + (\text{Number of single indirect pointer}) \times (\text{Address per block}] \times \text{BS}$$
$$= (10 + 2 \times 2^{10}) \times 2^{13}\text{ B}$$
$$= \left(\frac{10}{128} + 2^4\right) 2^{20}\text{ B} = 16.078\text{ MB}$$

QUESTION ANALYTICS +

Q. 15 — See your Answers

Consider following snapshot of a system with P_0, P_1, P_2 and P_3 processes and R_0, R_1 and R_2 resources types. In following table, 'Allocation' column shows number of resource types allocated to processes, and 'Max' column shows maximum requirement of a resource type by a process.

Process	Allocation			Max		
	R_0	R_1	R_2	R_0	R_1	R_2
P_0	1	0	2	3	4	5
P_1	0	1	0	3	4	5
P_2	0	3	1	2	5	2
P_3	1	1	2	2	6	6

A Above snapshot of system is in safe state. — Your option is **Correct**

B Only one order of processes possible to complete the execution of all processes. — Your answer is **IN-CORRECT**

C At this snapshot, P_1 requests for (R_0, R_1, R_2) = (0, 0, 1) instances and system allocate requested resources to P_1. Now, system still in safe state. — Your answer is **IN-CORRECT**

D At this snapshot, P_0 requests for (R_0, R_1, R_2) = (0, 0, 1) instances and system allocate requested resources to P_0. Now, system still in safe state. — Correct Option

YOUR ANSWER - a,b,c | CORRECT ANSWER - a,d | STATUS - ✗

Solution :

(a, d)

Use Banker's algorithm:

Total allocated resources $(R_0, R_1, R_2) = (2, 5, 5)$

Available resources at snapshot $(R_0, R_1, R_2) = (2, 2, 2)$

Required/need table:

Process	Need		
	R_0	R_1	R_2
P_0	2	4	3
P_1	3	3	5
P_2	2	2	1
P_3	1	5	4

Possible order for complete execution

1. P_2, P_0, P_1, P_3
2. P_2, P_0, P_3, P_1

(c) (0, 0, 1) allocated to P_1, now available resources = (2, 2, 1). Only P_2 can run. After P_2, available resources = (2, 5, 2). Now, it is deadlock.

(d) (0, 0, 1) allocated to P_0, now system in safe state, with two possible orders as shown above.

QUESTION ANALYTICS +

Q. 16 Have any Doubt ?

Which of the following is correct?

A. In multi-level feedback queue scheduling processes are not allowed to move from one queue to another.

B. Priority inversion is a condition that occurs in real-time system where lower priority process is starved because higher priority processes have gained hold of CPU. — Your answer is **IN-CORRECT**

C. User threads have higher thread scheduling overhead than Kernel threads.

D. When fork( ) system call creates a child process, then child process inherits all the open file descriptors of parent process. — Correct Option

Solution :

(d)

QUESTION ANALYTICS +

Q. 17 Have any Doubt ?

Consider a system uses TLB, two-level page table, and stores page table in memory. TLB and memory access time are 20 nanoseconds (ns) and 100 ns respectively. TLB have a cache hit ratio of 95%. What is effective access time of memory in nanoseconds?

130 — Your answer is **Correct**130

Solution :

130

H_T = Hit ratio of TLB

M_T = Miss ratio of TLB

T_T = Access time of TLB

T_M = Access time of memory

L = Levels in page table

Average access time of memory

$$= H_T \times (T_T + T_M) + M_T (T_T + L \times T_M + T_M)$$
$$= 0.95 \times (20 + 100) + 0.05 (20 + 2 \times 100 + 100)$$
$$= 0.95 \times 120 + 0.05 (320) = 114 + 16 = 130 \text{ ms}$$

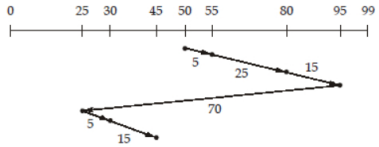
QUESTION ANALYTICS +

Q. 18 Have any Doubt ?

Consider a disk in which disk scheduler uses C-LOOK scheduling algorithm. At current instance disk has following requests (in track numbers).
55, 45, 95, 25, 30, 80
Disk has 100 tracks (0 to 99), currently disk head positioned at track 50 and pointing toward track 99. Assume head takes 1 ms to move from a track to its adjacent track and each request service time is negligible. The time taken by disk to service all disk requests shown above is _____ ms.

135 — Your answer is Correct135

Solution :
135



Total time = (Number of tracks traversed) × (Time for 1 track move)
= (5 + 25 + 15 + 70 + 5 + 15) × 1 = 135

QUESTION ANALYTICS +

Q. 19 — Have any Doubt ?

Consider a system with 48 bits virtual address space and 4 GB byte addressable physical memory. The operating system uses hierarchical paging where inner most level page table contains frame number and page tables at level other than inner most level contain address of page tables at its next-level, towards inner most table. Page table entry size at each level is 4 Bytes and page size is 4 KB. Page table at outer most level uses only one page, the amount of this page which is not used for page table is _____ bytes.

3840 — Your answer is Correct3840

Solution :
3840

Virtual address length = 48 bit
Virtual memory size = 2^{48} bytes
Page size (S) = 4 KB

Total number of pages in virtual memory = $\frac{2^{48}\ \text{B}}{4\ \text{KB}} = 2^{36}$ pages

Number of page table entries (PTE) = Number of virtual pages = 2^{36}

Number of pages at level-1 (inner most level)

$$= \frac{(\text{Number of PTE}) \times (\text{PTE size})}{\text{Page size}} = \frac{2^{36} \times 4\text{B}}{4\ \text{KB}} = 2^{26}$$

$$\text{Number of pages at level-2} = \frac{(\text{Number of pages at level-1}) \times (\text{PTE size})}{\text{Page size}} = \frac{2^{26} \times 4\text{B}}{4\ \text{KB}} = 2^{16}$$

$$\text{Number of pages at level-3} = \frac{(\text{Number of pages at level-2}) \times (\text{PTE size})}{\text{Page size}} = \frac{2^{16} \times 4\text{B}}{4\ \text{KB}} = 2^{6}$$

$$\text{Number of pages at level-4} = \left\lceil \frac{(\text{Number of pages at level-3}) \times (\text{PTE size})}{\text{Page size}} \right\rceil = \left\lceil \frac{2^{6} \times 4\text{B}}{4\ \text{KB}} \right\rceil = 1 \text{ page}$$

Space used at level-4 page = (Number of pages at level-3) × (PTE size)
= $2^6 \times 4$ B

Unused space in page at level-4
= $(4 \times 2^{10} - 4 \times 2^6)$ Bytes
= $4 \times 2^6 (2^4 - 1) = 3840$ bytes

QUESTION ANALYTICS +

Q. 20 — Have any Doubt ?

Which of the following is false?

A. User-level thread switching requires user-mode to Kernel-mode conversion of their process. — Correct Option

Solution :
(a)
User-level threads managed in user space using user-thread libraries. These is no need of Kernel in user-thread libraries.

B. Threads of a process created within the address space of this process.

C. In user-level threads of a process, if one thread blocked then entire process will block.

D. Threads of a process share the protected access to other processes which are connected to process of these threads as inter-process communication. — Your answer is IN-CORRECT

QUESTION ANALYTICS +